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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/751,453	01/02/2001	Kee Jeung Lee	M 275264 HD943/US	7152

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EXAMINER

RAO, SHRINIVAS H

ART UNIT

PAPER NUMBER

2814

DATE MAILED: 08/12/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/751,453

Applicant(s)

LEE ET AL.

Examiner

Steven H. Rao

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 22 May 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☐ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 12/20/03 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_.
- 4) ☐ Interview Summary (PTO-413) Paper No(s) \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

## **DETAILED ACTION**

### ***Priority***

Receipt is acknowledged of paper submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

### ***Request for Continued Examination Application***

The request filed on 05/16/2003 for a Request for Continued Examination application (RCE) under 37 CFR 1.114 based on parent Application No. 09/751, 453 is acceptable and a RCE has been established. An action on the RCE follows.

### ***Preliminary Amendment Status***

Acknowledgment is made of entry of preliminary amendment filed 11 /20/2003 has been entered on May 22, 2003 and the amendment faxed on August 05, 2003 has been entered on August 06, 2003..

Therefore claims 1 and 20 as amended by the supplemental amendment and claims 2 to 18 as previously amended are currently pending in the application.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and

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the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-4 are rejected under 35 U.S.C. 103(a) as being unpatentable over DeBoer et al. ( U. S. patent No. 5,910,880, herein after DeBoer).

With respect to claim 1, DeBoer describes a method of making a semiconductor device-capacitor ,including the steps of : forming a lower electrode on a semiconductor substrate ( DeBoer fig. 2 # 32substrate, # 34 -lower electrode, col. 3 lines 48-49); forming a dielectric layer on the lower electrode ( fig. 2 # 36-col. 3 line 55) by forming a first amorphous TaON thin film on the lower electrode ( col. 2 line 3-5 amorphous TaON, fig. 2 # 38, col. 2 line 57) and annealing the first amorphous TaON layer in an NH<sub>3</sub> atmosphere (col. 4 line 41); forming a second amorphous TaON thin film on the lower electrode ( fig. 2 # 40, col. 4 lines 8-23); annealing the second amorphous TaON

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thin film to form a multiplayer TaON dielectric film ( col. 4 line 37-38) and forming an upper electrode over the TaON dielectric layer film ( fig. 2 # 44, col. 5 line 3-5).

The newly added limitation of, " nitriding an upper surface of the lower electrode using in-situ plasma before forming a first amorphous TaON thin film " ( col. 4 lines 39-41, wherein first amorphous layer 38 is converted to crystalline form similar to applicants' specification by treating it with ammonia-comprising gas i.e. nitriding the upper surface of lower electrode).

With respect to claim 2, to the extent understood, wherein the lower and upper electrodes are formed by a single/plural conductive layers of doped polysilicon and metal. ( DeBoer Col. 2 lines 15-18)

With respect to claim 3, wherein the metal is selected from TiN, Ti, TaN, W, WN, Wsi, Ru, RuO<sub>2</sub>, Ir and Pt. (DeBoer Col. 2 line 16).

With respect to claim 4, wherein the lower electrode is formed of doped polysilicon having hemispherical grain structure. ( DeBoer col. 1 line 24-25).

**B.** Claims 5- 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over DeBoer et al. ( U. S. patent No. 5,910,880, herein after DeBoer) as applied to claims 1-4 above and further in view of Yang et al. ( U.S. Patent No. 5,956,594, herein after Yang).

With respect to claims 5 and 6, wherein the forming of the lower electrode includes the steps of : forming a polysilicon layer and removing the natural oxide formed on the polysilicon lower electrode by an in-situ dry cleaning process utilizing HF, SiF<sub>4</sub>, or

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NF<sub>4</sub>, or an ex-situ wet cleaning process using HF and cleaning the lower electrode with Ammonia or Sulfuric acid .

DeBoer describes the formation of an lower electrode.

DeBoer does not describe the cleaning steps.

However, Yang, a patent from the same filed of endeavor describes in col. 3 lines 64-col. 3 lines 1-4, a cleaning step using Hot phosphoric acid solution or buffered Hydrofluoric acid to form a clean surface on which additional layers can be formed.( Yang fig. 4 col. 4 lines 6-10).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to Include Yang's cleaning step in DeBoer's method to obtain a clean surface on which additional layers can be formed.

With respect to claim 7, wherein the first and second amorphous TaON film is deposited in a LPCVD chamber maintained at a temperature less than 600 ° C. (DeBoer col. 4 line line 31 and col. 21 line 21).

With respect to claim 8, wherein the Ta containing gas is obtained by evaporating the Ta( OC<sub>2</sub>H<sub>5</sub>)<sub>5</sub> between 150-200 degrees and injecting the Ta( OC<sub>2</sub>H<sub>5</sub>)<sub>5</sub> into the LPCVD chamber ( DeBoer col. 4 lines 6-23).

With respect to claim 9, to the extent understood, wherein the Ta-containing vapor is supplied in a controlled manner by a mass flow controller and at a pressure of less than 10 Torr ( as stated above the apparatus for performing the process cannot be given patentable weight because of improper claim format and Yang LPCVD- is inherently low pressure as name suggests i.e. less than 10 Torr ).

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With respect to claim 10, to the extent understood, wherein the introducing Oxygen gas in 5 to 500 sccm. ( DeBoer col. 1 lines 67).

With respect to claims 11 and 12 , to the extent understood, wherein the chemical vapor is sprayed substantially perpendicularly and parabolic to the lower electrode ( well known in the art).

With respect to claim 13, to the extent understood ,wherein the first and second injectors are used to form counter-current flow of the gas.( the first and second injectors cannot be given patentable weight and counter-current flow is well known).

With respect to claim 14, wherein annealing is carried out by plasma in ammonia or Nitrous oxide atmosphere (DeBoer col. 4 lines 18-23).

With respect to claims 15 and 16, wherein the low-temperature annealing is carried out in a UV-ozone or ozone atmosphere or nitrous oxide, oxygen or nitrogen( DeBoer col. 1 lines 64-65, lines 64-67, col. 2 lines 1-10).

With respect to claims 17 and 18 , wherein the lower electrode is nitrided by in-situ plasma under ammonia for 1-5 minutes (DeBoer col. 4 lines 18-23 and lines 4730 seconds to 10 minutes).

With respect to claim 20, it repeats the steps of claims 1,2 and 17 and is rejected for reasons stated above including the limitations added by the amendment of, November 22, 2002.

### ***Response to Arguments***

Applicant's arguments filed on November 20, 2002 have been fully considered but they are not persuasive because Applicants' contention that DeBoer does not teach

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or suggest nitriding an upper surface of the lower electrode is at odds with DeBoer's teaching in coloum 4 lines 39-41 state :

38 in an amorphous form. In contrast, it may be desired to utilize an ammonia-comprising gas when it is desired to convert an amorphous  $Ta_2O_5$  layer 38 to a crystalline form.

And in col. 4 lines 46-50 state:

first tantalum-comprising layer 38 is preferably exposed to the nitrogen-comprising ambient for a time of from about 30 seconds to about 10 minutes. It is noted that the formation of second tantalum-comprising layer 40 from the interaction

This DeBoer teaches/describes nitriding an upper surface of the lower electrode ( layer 38 by passing ammonia – i.e. nitriding) and therefore none of the claims are allowable.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Steven H. Rao whose telephone number is 703-306-5945. The examiner can normally be reached on M-F, 8.00 to 5.00.

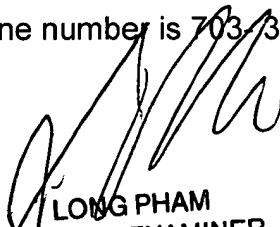
The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-3080956.

  
Steven H. Rao

Patent Examiner

05/02/03

  
LONG PHAM  
PRIMARY EXAMINER